

CLAIMS

1. A corrosion-inhibiting seal for a barrier film comprising cobalt, wherein the cobalt is trivalent cobalt, tetravalent cobalt, or combinations thereof, and a valence stabilizer combined to form a cobalt/valence stabilizer complex.
2. The corrosion-inhibiting seal of claim 1 wherein the cobalt/valence stabilizer complex has a solubility in water of between about 5×10^{-1} and about 1×10^{-5} moles per liter of cobalt.
3. The corrosion-inhibiting seal of claim 2 wherein the solubility of the cobalt/valence stabilizer complex in water is between about 5×10^{-2} and about 5×10^{-5} moles per liter of cobalt.
4. The corrosion-inhibiting seal of claim 1 wherein there is an electrostatic barrier layer around the cobalt/valence stabilizer complex in aqueous solution.
5. The corrosion-inhibiting seal of claim 1 wherein the cobalt/valence stabilizer complex acts as an ion exchange agent towards corrosive ions.
6. The corrosion-inhibiting seal of claim 1 wherein the barrier film comprises a compound selected from oxides, hydroxides, phosphates, carbonates, oxalates, silicates, aluminates, borates, and polymers, and combinations thereof.
7. The corrosion-inhibiting seal of claim 1 wherein the valence stabilizer is an inorganic valence stabilizer or an organic valence stabilizer.
8. The corrosion-inhibiting seal of claim 7 wherein the valence stabilizer is the inorganic valence stabilizer selected from molybdates, tungstates, vanadates, niobates, tantalates, tellurates, periodates, iodates, carbonates, antimonates, stannates, titanates, zirconates, hafnates, bismuthates, germanates, arsenates, phosphates, borates, aluminates, and silicates, and combinations thereof.

9. The corrosion-inhibiting seal of claim 8 wherein the inorganic valence stabilizer is selected from molybdates, tungstates, vanadates, niobates, tantalates, tellurates, periodates, iodates, carbonates, antimonates, and stannates, and combinations thereof.

5 10. The corrosion-inhibiting seal of claim 8 wherein the cobalt/valence stabilizer complex has a central cavity containing a cobalt ion and an additional ion.

11. The corrosion-inhibiting seal of claim 10 wherein the additional ion is B^{+3} , Al^{+3} , Si^{+4} , P^{+5} , Ti^{+4} , V^{+5} , V^{+4} , Cr^{+6} , Cr^{+3} , Mn^{+4} , Mn^{+3} , Mn^{+2} , Fe^{+3} , Fe^{+2} , Co^{+2} , Ni^{+2} , Ni^{+3} , Ni^{+4} , Cu^{+2} , Cu^{+3} , Zn^{+2} ,
10 Ga^{+3} , Ge^{+4} , As^{+5} , As^{+3} , Zr^{+4} , or Ce^{+4} .

12. The corrosion-inhibiting seal of claim 7 wherein the valence stabilizer is the organic valence stabilizer selected from monoamines; diamines; triamines; tetraamines; pentamines; hexamines; five- or six-membered heterocyclic rings containing one to four nitrogen atoms optionally having additional nitrogen, sulfur, or oxygen binding sites; five- or six-membered heterocyclic rings containing one or two sulfur atoms and having additional nitrogen binding sites; five- or six-membered heterocyclic rings containing one or two oxygen atoms and having additional nitrogen binding sites; (two-, three-, four-, six-, eight-, or ten-)membered nitrogen, nitrogen-sulfur, or nitrogen-oxygen macrocyclics; macrocyclic oligothioketones or dithiolenes; diazenes; thio-, amido-, or imido- derivatives of hypophosphoric, phosphoric, or diphosphoric acids and salts; azo compounds, formazans, azines, hydrazones, or Schiff Bases containing at least two azo, imine, or azine groups; azo compounds, formazans, azines, hydrazones, or Schiff Bases with ortho- (for aryl) or alpha- or beta- (for alkyl) substitution; oximes; amidines and imido compounds; dithio ligands; amides; amino acids; N-(thio)acyl 7-aminobenzylidenimines;
25 (thio)hydroxamates; alpha- or ortho-aminothio(di)carboxylic acids and salts; (thio)semicarbazones; (thio)acyl hydrazones; (thio)carbazones; silylaminoalcohols; thioalkyl amines and imines; hydroxyalkyl imines; (thio)aryl amines and imines; guanylureas; guanidinoureas; 2-nitrosophenols; 2-nitrophenols; N-nitrosohydroxylamines; 1,3-monothioketones; monothiomalonamides; 2-thioacylacetamides; 2-acylthioacetamides;
30 dithiodicarbonic diamides; trithiodicarboxylic acids and salts; monothiocarbamates; monothioethers; dithioethers; trithioethers; tetrathioethers; pentathioethers; hexathioethers;

disulfides; monophosphines; diphosphines; triphosphines; tetraphosphines; pentaphosphines; hexaphosphines; five- or six-membered heterocyclic rings containing one or two sulfur atoms optionally having additional sulfur, oxygen, or phosphorus binding sites; five- or six-membered heterocyclic rings containing one to three phosphorus atoms optionally having additional phosphorus, nitrogen, oxygen, or sulfur binding sites; five- or six-membered heterocyclic rings containing one to four nitrogen atoms and having additional phosphorus binding sites; five- or six-membered heterocyclic rings containing one or two oxygen atoms and having additional sulfur or phosphorus binding sites; (five-, seven-, or nine-)membered nitrogen, nitrogen-sulfur, or nitrogen-oxygen macrocyclics; (two- to ten-)membered sulfur, sulfur-oxygen, or sulfur-phosphorus macrocyclics, not including oligothioketones or dithiolenes; (two- to ten-)membered phosphorus, nitrogen-phosphorus, or oxygen-phosphorus macrocyclics; thio-, amido-, or imido-derivatives of phosphonic and diphosphonic acids and salts containing no sulfur binding sites; amido-, or imido- derivatives of hypophosphoric, phosphoric, or diphosphoric acids and salts containing no sulfur binding sites; dithioperoxydiphosphoramides; dithioperoxydiphosphoric acids and salts; monothioperoxydiphosphoramides; monothioperoxydiphosphoric acids and salts; monothiophosphoric acids; phosphoro(dithioperoxoic) acids and salts; azo compounds, formazans, azines, or Schiff Bases; silylamines; silazanes; guanidines and diguanidines; pyridinaldimines; hydrazones; hydramides; nitriles; thioureas and thioamides; ureas and biurets; monothio ligands; diketone ligands; dithioacyl disulfides; tetrathioperoxydicarbonic diamides; (hexa-, penta-, or tetra-)thioperoxydicarbonic acids and salts; 1,2-dithiolates; rhodanines; dithiocarbimates; (thio)xanthates; S-(alkyl- or aryl-thio)thiocarboxylic acids and salts; phosphinodithioformates; (thio)borates and (thio)boronates; (thio)arsonic acids and salts; (thio)antimonic acids and salts; phosphine and arsine sulfides or oxides; beta-hydroxyketones and -aldehydes; squaric acids and salts; carbonates; carbamates and carbimates; carbazates; imidosulfurous diamides; sulfurdiimines; thiocarbonyl and mercapto oximes; 2-nitrothiophenols; 2-nitrilo(thio)phenols; acylcyanamides, imidates; 2-amidinoacetates; beta-ketoamines; 3-aminoacrylamides and 3,3-diaminoacrylamides; 3-aminoacrylic acids and salts and 3-hydroxy-3-aminoacrylic acids and salts; 2-nitroanilines; amine and diazine N-oxides; hydrazides and semicarbazides; (amino- or imino-)aryl phosphines; (thio- or hydroxy-)aryl phosphines; arsines; five- or six-membered heterocyclic rings containing one arsenic atom optionally having additional arsenic binding sites; (two- to six-)membered arsenic macrocyclics; selenoethers; five-

or six-membered heterocyclic rings containing one or two selenium atoms optionally having additional selenium binding sites; (two- to six-)membered selenium macrocyclics; 1,3-diselenoketones; 1,1-diselenolates; diselenocarbamates; selenophosphoric acids and salts; selenocarbonates; cyanide, isocyanide, and cyanamide ligands; nitrosyl and nitrite ligands; azide ligands; thiolates and selenolates; (thio)cyanate ligands; diene or bicyclic or tricyclic hydrocarbon ligands; and carbonyl, halogen, and hydroxo ligands; and combinations thereof.

13. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is selected from monoamines; diamines; triamines; tetraamines; pentamines; hexamines; five- or six-membered heterocyclic rings containing one to four nitrogen atoms optionally having additional nitrogen, sulfur, or oxygen binding sites; five- or six-membered heterocyclic rings containing one or two sulfur atoms and having additional nitrogen binding sites; five- or six-membered heterocyclic rings containing one or two oxygen atoms and having additional nitrogen binding sites; (two-, three-, four-, six-, eight-, or ten-)membered nitrogen, nitrogen-sulfur, or nitrogen-oxygen macrocyclics; macrocyclic oligothioketones or dithiolenes; diazenes; thio-, amido-, or imido- derivatives of hypophosphoric, phosphoric, or diphosphoric acids and salts; azo compounds, formazans, azines, hydrazones, or Schiff Bases containing at least two azo, imine, or azine groups; azo compounds, formazans, azines, hydrazones, or Schiff Bases with ortho- (for aryl) or alpha- or beta- (for alkyl) substituted azo compounds, formazans, azines, hydrazones, or Schiff Bases; oximes; amidines and imido compounds; dithio ligands; amides; amino acids; N-(thio)acyl 7-aminobenzylidenimines; (thio)hydroxamates; alpha- or ortho-aminothio(di)carboxylic acids and salts; (thio)semicarbazones; (thio)acyl hydrazones; (thio)carbazones; silylaminoalcohols; thioalkyl amines and imines; hydroxyalkyl imines; (thio)aryl amines and imines; guanylureas; guanidinoureas; 2-nitrosophenols; 2-nitrophenols; N-nitrosohydroxylamines; 1,3-monothioketones; monothiomalonamides; 2-thioacylacetamides; 2-acylthioacetamides; dithiodicarboxylic diamides; trithiodicarboxylic acids and salts; and monothiocarbamates; and combinations thereof.

14. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is diazenes selected from diazeneformimidamides; diazeneformamides; diazeneformothioamides; diazeneacetimidamides; diazeneacetothioamides; diazeneformimidic acids and salts;

diazeneacetimidic acids and salts; diazenecarbothioic acids and salts; diazenecarbodithioic acids and salts; diazeneformimidothioic acids and salts; diazeneformaldehydes; diazeneformothioaldehydes; diazeneacetaldehydes; diazeneacetothioaldehydes; diazenediformamides; diazenediformothioamides; diazenediacetamides; diazenediacetothioamides; diazeneacetimidothioic acids and salts; imidoaldiazenes; diazenediformimidamides; diazenediacetimidamides; diazenediformimidic acids and salts; diazenediacetimidic acids and salts; diazenediformimidothioic acids and salts; diazenediacetimidothioic acids and salts; diazenedicarbothioic acids; diazenedicarbodithioic acids; diazeneformic acids; diazenediformic acids; diazeneacetic acids; diazenediacetic acids; diazenediformaldehydes; diazenediformothioaldehydes; diazenediacetaldehydes; diazenediacetothioaldehydes; and diimidoaldiazenes; and combinations thereof.

15. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is thio-, amido-, or imido- derivatives of hypophosphoric, phosphoric, or diphosphoric acids and salts selected from phosphoramidimidic triamides; phosphoramidimidic acids and salts; phosphorodiamidimidic acids and salts; phosphorodiamidimidothioic acids and salts; phosphoramidimidothioic acids and salts; phosphorodiamidimidodithioic acids and salts; phosphoramidimidodithioic acids and salts; (di- or mono-)thiohypophosphoric acids and salts; (di- or mono-)thiohypophosphoramides; phosphoramidic acids and salts; phosphorimidic acids and salts; (di- or mono-)thioimidodiphosphoric acids and salts; (di- or mono-)thiohydrazidodiphosphoric acids and salts; (di- or mono-)thioimidodiphosphoramides; (di- or mono-)thiohydrazidodiphosphoramides; phosphoric triamides; (di- or mono-)thiodiphosphoramides; (di- or mono-)thiodiphosphoric acids and salts; (tetra-, tri-, di-)thiophosphoric acids and salts; phosphoro(dithioperoxo)(mono-, di-, or tri-)thioic acids and salts; phosphorimido(mono-, di-, or tri-)thioic acids and salts; phosphorothioic triamides; phosphoramido(mono, di- or tri-)thioic acids and salts; and phosphorodiamido(mono, di- or tri-)thioic acids and salts; and combinations thereof.

16. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is azo compounds, formazans, azines, hydrazones, or Schiff Bases with ortho- (for aryl) or alpha- or

beta- (for alkyl) substitution and wherein a substituent is selected from amino; imino; oximo; diazeno; hydrazido; thiol; mercapto; thiocarbonyl; hydroxy; carbox; and carbonyl substituents.

17. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is oximes selected from monooximes; dioximes; carbonyl oximes; imine oximes; hydroxy oximes; amino oximes; amido oximes; hydrazone oximes; and azo oximes; and combinations thereof.

18. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is amidines and imido compounds selected from amidines; diamidines; biguanides; biguanidines; diamidinomethanes; imido-ylguanidines; amidinoguanidines; diformamidine oxides, sulfides, and disulfides; imidodicarbonimidic acids and salts; diimidodicarbonimidic acids and salts; thioimidodicarbonimidic acids and salts; thiodiimidodicarbonimidic acids and salts; diimidoylimines; diimidoylhydrazides; imidosulfamides; diimidosulfamides; O-amidinocarbamates; O- or S-amidino(mono-, di-, or peroxy-)thiocarbamates; N-hydroxy(or N,N'-dihydroxy)amidines; and diimidosulfuric acids and salts; and combinations thereof.

19. The corrosion-inhibiting seal of claim 14 wherein the organic valence stabilizer is dithio ligands selected from dithioimidodialdehydes; dithiohydrazidodialdehydes; dithioimidodicarbonic acids and salts; dithiohydrazidodicarbonic acids and salts; 1,3-dithioketones; 1,2-dithioketones; dithiomalonamides; 2-thioacylthioacetamides; dithioacyl sulfides; trithiodicarbonic diamides; (penta-, tetra-, tri-)thiodicarbonic acids and salts; beta-mercaptothioketones and -aldehydes; N-(aminomethylthiol)thioureas; dithiooxamides; 1,1-dithiolates; (di- or per-)thiomonocarboxylic acids and salts; (tetra- or per-)thiodicarboxylic acids and salts; (di-, tri-, or per-)thiocarbonates; dithiocarbamates (including N-hydroxydithiocarbamates and N-mercaptodithiocarbamates); and dithiocarbazates; and combinations thereof.

20. The corrosion-inhibiting seal of claim 14 wherein the organic valence stabilizer is amides selected from monoamides; lactams; amidinoamides; guanidinoamides; imido-ylamides; polyamides; and polylactams; and combinations thereof.

21. The corrosion-inhibiting seal of claim 14 wherein the organic valence stabilizer is thio-, amido-, or imido- derivatives of phosphonic and diphosphonic acids and salts selected from phosphonitrile amides; phosphonimidic diamides; phosphonamidimidic acids and salts; phosphonamidimidothioic acids and salts; dithioimidodiphosphonic acids and salts; dithiohydrazidodiphosphonic acids and salts; dithioimidodiphosponamides; dithiohydrazidodiphosponamides; dithiodiphosponamides; dithiodiphosphonic acids and salts; dithioperoxydiphosponamides; dithioperoxydiphosphonic acids and salts; (di- and tri-)thiophosphonic acids and salts; phosphono(dithioperoxo)thioic acids and salts; phosphono(dithioperoxo)dithioic acids and salts; phosphonimidothioic acids and salts; phosphonimidodithioic acids and salts; phosphonothioic acids and salts; phosphonanidothioic acids and salts; phosphonamidimidodithioic acids and salts; monothioimidodiphosphonic acids and salts; monothiohydrazidodiphosphonic acids and salts; monothioimidodiphosponamides; monothiohydrazidodiphosponamides; monothiodiphosponamides; monothiodiphosphonic acids and salts; monothioperoxydiphosponamides; monothioperoxydiphosphonic acids and salts; monothiophosphonic acids and salts; and phosphono(dithioperoxoic) acids and salts; and combinations thereof.

22. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is amido-, or imido- derivatives of hypophosphoric, phosphoric, or diphosphoric acids and salts containing no sulfur binding sites selected from hypophosphoric acids and salts; hypophosphoramides; imidodiphosphoric acids and salts; hydrazidodiphosphoric acids and salts; imidodiphosphoramides; hydrazidodiphosphoramides; and diphosphoramides; and combinations thereof.

23. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is amido-, or imido- derivatives of phosphonic or diphosphonic acids and salts containing no sulfur binding sites selected from imidodiphosphonic acids and salts; hydrazidodiphosphonic acids and salts; imidodiphosponamides; hydrazidodiphosponamides; diphosponamides; phosphonimidic acids and salts; phosphonamidic acids and salts; and phosphonic diamides; and combinations thereof.

24. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is thioureas and thioamides selected from thioureas; thiocarboxamides; thioacylthioureas, acylthioureas, and thioacylureas; thioaroylthioureas, aroylthioureas, and thioaroylureas; thioimides; thioguanylureas; guanidinothioureas; amidinothioamides; guanidinothioamides; imidoylthioamides; 3-aminothioacrylamides; thiohydrazides; thiosemicarbazides; (mono- and di-)thiobiurets; (mono- and di-)thioisobiurets; (mono- and di-)thiobiureas; N-(aminomethylol)thioureas; N-(aminomethylthiol)ureas; and beta-mercaptocarboxamides; and combinations thereof.

25. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is ureas and biurets selected from ureas and pseudoureas; biurets, isobiurets, and biureas; acylureas; aroylureas; and N-(aminomethylol)ureas; and combinations thereof.

26. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is monothio ligands selected from beta-aminothiones; 3-aminothioacrylic acids and salts; 3-mercapto-3-aminothioacrylic acids and salts; N-thioacyl benzylidenimines; thioimidodialdehydes; thiohydrazidodialdehydes; thioimidodicarbonic acids and salts; thiohydrazidodicarbonic acids and salts; 1,2-monothioketones; trithioperoxydicarbonic diamides; dithioperoxydicarbonic diamides; dithiodicarbonic acids and salts; trithioperoxydicarbonic acids and salts; beta-hydroxythioketones; beta-hydroxythioaldehydes; beta-mercaptoketones; beta-mercaptoaldehydes; monothiooxamides; beta-mercaptocarboxylic acids and salts; beta-mercaptothiocarboxylic acids and salts; beta-hydroxythiocarboxylic acids and salts; S-alkylthiocarboxylic acids and salts; S-arylthiocarboxylic acids and salts; S-alkyldisulfidocarboxylic acids and salts; S-aryldisulfidocarboxylic acids and salts; monothiomonocarboxylic acids and salts; dithiodicarboxylic acids and salts; monothiocarbonates; monothiocarbazates; monothiocarbimides; mercaptoalcohols; and silylmercaptoalcohols; and combinations thereof.

27. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is diketone ligands selected from imidodialdehydes; hydrazidodialdehydes; imidodicarbonic acids and salts; hydrazidodicarbonic acids and salts; imidodisulfamic acids and salts; imidodisulfuric

acids and salts; 1,3-diketones; 1,2-diketones; malonamides; 2-acylacetamides; monothiodicarbonyl diamides; monothiodicarbonyl acids and salts; dithioperoxydicarbonyl acids and salts; trithionic acids and salts; oxamides; and dicarboxylic acids; and combinations thereof.

- 5 28. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is S-(alkyl- or aryl-thio)thiocarboxylic acids and salts selected from S-(alkylthio)thiocarboxylic acids and salts; S-(arylthio)thiocarboxylic acids and salts; S,S-thiobisthiocarboxylic acids and salts; S-(alkyldisulfido)thiocarboxylic acids and salts; S-(aryldisulfido)thiocarboxylic acids and salts; and S,S'-disulfidobisthiocarboxylic acids and salts; and combinations thereof.

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29. The corrosion-inhibiting seal of claim 12 wherein the organic valence stabilizer is phosphine and arsine sulfides or oxides selected from phosphine P-sulfides; aminophosphine sulfides; arsine As-sulfides; aminoarsine sulfides; phosphine P-oxides; aminophosphine oxides; arsine As-oxides; and aminoarsine oxides; and combinations thereof.

30. The corrosion-inhibiting seal of claim 12 wherein a solubility of the cobalt/valence stabilizer complex in water is adjusted by an addition of a substituent group on the organic valence stabilizer.

- 20 31. The corrosion-inhibiting seal of claim 30 wherein the solubility of the cobalt/valence stabilizer complex in water is increased by the addition of the substituent group selected from sulfonate groups ($-\text{SO}_3^-$), carboxyl groups ($-\text{CO}_2^-$), hydroxyl groups ($-\text{OH}$), ester groups ($-\text{CO}_3^-$), carbonyl groups ($=\text{C}=\text{O}$), amine groups ($-\text{NH}_2$), nitrosamine groups ($=\text{N}-\text{N}=\text{O}$), carbonylnitrene groups ($-\text{CO}-\text{N}$), sulfoxide groups ($=\text{S}=\text{O}$), sulfone groups ($=\text{S}[\text{=O}]_2$), sulfinyl groups ($-\text{N}=\text{S}=\text{O}$),
 25 sulfodiimines ($=\text{S}[\text{=NH}]_2$), sulfonyl halide groups ($-\text{S}[\text{=O}]_2\text{X}$), sulfonamide groups ($-\text{S}[\text{=O}]_2\text{NH}_2$), monohalosulfonamide groups ($-\text{S}[\text{=O}]_2\text{NHX}$), dihalosulfonamide groups ($-\text{S}[\text{=O}]_2\text{MX}_2$), halosulfonate groups ($-\text{S}[\text{=O}]_2\text{OX}$), halosulfonate amide groups ($=\text{N}-\text{S}[\text{=O}]_2\text{X}$), aminosulfonate groups ($=\text{N}-\text{S}[\text{=O}]_2\text{OH}$), iminosulfonate groups ($-\text{N}[\text{SO}_3^-]_{1-2}$), phosphonate groups ($-\text{PO}_3^{2-}$), phosphonamide groups ($-\text{PO}_2\text{NH}_2^-$), phosphondiamide groups ($-\text{PO}[\text{NH}_2]_2$),
 30 aminophosphonate groups ($=\text{N}-\text{PO}_3^{2-}$), and iminophosphonate groups ($-\text{N}[\text{PO}_3^{2-}]_{1-2}$), and combinations thereof.

32. The corrosion-inhibiting seal of claim 30 wherein the solubility of the cobalt/valence stabilizer complex in water is decreased by the addition of the substituent group selected from nitro groups ($-\text{NO}_2$), perfluoroalkyl groups ($-\text{C}_x\text{F}_{2x+1}$), perchloroalkyl groups ($-\text{C}_x\text{Cl}_{2x+1}$), nitramine groups ($=\text{N}-\text{NO}_2$), thioketone groups ($=\text{C}=\text{S}$), sulfenyl halide groups ($-\text{S}-\text{X}$), and sulfur dihaloimide groups ($-\text{N}=\text{SX}_2$), and combinations thereof.

33. The corrosion-inhibiting seal of claim 12 wherein an electrostatic barrier layer of the cobalt/valence stabilizer complex is adjusted by an addition of a substituent group on the organic valence stabilizer.

34. The corrosion-inhibiting seal of claim 33 wherein the electrostatic barrier layer is increased by the addition of the substituent group selected from ketones ($=\text{C}=\text{O}$), thioketones ($=\text{C}=\text{S}$), amides ($-\text{C}[\text{=O}]-\text{NR}_2$), thioamides ($-\text{C}[\text{=S}]-\text{NR}_2$), nitriles or cyano groups, ($-\text{CN}$), isocyanides ($-\text{NC}$), nitroso groups ($-\text{N}=\text{O}$), thionitroso groups ($-\text{N}=\text{S}$), nitro groups ($-\text{NO}_2$), azido groups ($-\text{N}_3$), cyanamide or cyanonitrene groups ($=\text{N}-\text{CN}$), cyanate groups ($-\text{O}-\text{CN}$), isocyanate groups ($-\text{N}=\text{C}=\text{O}$), thiocyanate groups ($-\text{S}-\text{CN}$), isothiocyanate groups ($-\text{N}=\text{C}=\text{S}$), nitrosamine groups ($=\text{N}-\text{N}=\text{O}$), thionitrosamine groups ($=\text{N}-\text{N}=\text{S}$), nitramine groups ($=\text{N}-\text{NO}_2$), thionitramine groups ($=\text{N}-\text{NS}_2$), carbonylnitrene groups ($-\text{CO}-\text{N}$), thiocarbonylnitrene groups ($-\text{CS}-\text{N}$), sulfenyl halides ($-\text{S}-\text{X}$), sulfoxides ($=\text{S}=\text{O}$), sulfones ($=\text{S}[\text{=O}]_2$), sulfinyl groups ($-\text{N}=\text{S}=\text{O}$), thiosulfinyl groups ($-\text{N}=\text{S}=\text{S}$), sulfenyl thiocyanato groups ($-\text{S}-\text{S}-\text{CN}$), sulfenyl cyanato groups ($-\text{S}-\text{O}-\text{CN}$), sulfodiimine groups ($=\text{S}[\text{=NH}]_2$), sulfur dihaloimido groups ($-\text{N}=\text{SX}_2$), sulfur oxide dihaloimido groups ($-\text{N}=\text{S}[\text{=O}]\text{X}_2$), aminosulfur oxide trihalide groups ($=\text{N}-\text{S}[\text{=O}]\text{X}_3$), sulfonyl azide groups ($-\text{S}[\text{=O}]_2\text{N}_3$), sulfonyl thiocyanate groups ($-\text{S}[\text{=O}]_2\text{SCN}$), sulfonyl cyanate groups ($-\text{S}[\text{=O}]_2\text{OCN}$), sulfonyl cyanide groups ($-\text{S}[\text{=O}]_2\text{CN}$), halosulfonate groups ($-\text{S}[\text{=O}]_2\text{OX}$), phosphonyl thiocyanate groups ($-\text{P}[\text{=O}]\text{OHSCN}$), phosphonyl cyanate groups ($-\text{P}[\text{=O}]\text{OHOCN}$), and phosphonyl cyanide groups ($-\text{P}[\text{=O}]\text{OHCN}$), and combinations thereof.

35. The corrosion-inhibiting seal of claim 1 further comprising an optional solubility control agent.

36. The corrosion-inhibiting seal of claim 35 wherein the solubility control agent is a cationic solubility control agent or an anionic solubility control agent.

37. The corrosion-inhibiting seal of claim 36 wherein the solubility control agent is the cationic solubility control agent selected from H^+ , Li^+ , Na^+ , K^+ , Rb^+ , Cs^+ , NH_4^+ , Mg^{+2} , Ca^{+2} , Sr^{+2} , Be^{+2} , Ba^{+2} , Y^{+3} , La^{+3} , Ce^{+3} , Ce^{+4} , Nd^{+3} , Pr^{+3} , Sc^{+3} , Sm^{+3} , Eu^{+3} , Eu^{+2} , Gd^{+3} , Tb^{+3} , Dy^{+3} , Ho^{+3} , Er^{+3} , Tm^{+3} , Yb^{+3} , Lu^{+3} , Ti^{+4} , Zr^{+4} , Ti^{+3} , Hf^{+4} , Nb^{+5} , Ta^{+5} , Nb^{+4} , Ta^{+4} , V^{+5} , V^{+4} , V^{+3} , Mo^{+6} , W^{+6} , Mo^{+5} , W^{+5} , Mo^{+4} , W^{+4} , Cr^{+3} , Mn^{+2} , Mn^{+3} , Mn^{+4} , Fe^{+2} , Fe^{+3} , Co^{+2} , Co^{+3} , Ni^{+2} , Ni^{+3} , Ni^{+4} , Ru^{+2} , Ru^{+3} , Ru^{+4} , Rh^{+3} , Ir^{+3} , Rh^{+2} , Ir^{+2} , Pd^{+4} , Pt^{+4} , Pd^{+2} , Pt^{+2} , Os^{+4} , Cu^+ , Cu^{+2} , Cu^{+3} , Ag^+ , Ag^{+2} , Ag^{+3} , Au^+ , Au^{+2} , Au^{+3} , Zn^{+2} , Cd^{+2} , Hg^+ , Hg^{+2} , Al^{+3} , Ga^{+3} , Ga^+ , In^{+3} , In^+ , Tl^{+3} , Tl^+ , Ge^{+4} , Ge^{+2} , Sn^{+4} , Sn^{+2} , Pb^{+4} , Pb^{+2} , Sb^{+3} , Sb^{+5} , As^{+3} , As^{+5} , Bi^{+3} , Bi^{+5} , organic compounds containing at least one N^+ site, organic compounds containing at least one phosphonium site, organic compounds containing at least one arsonium site, organic compounds containing at least one stibonium site, organic compounds containing at least one oxonium site, organic compounds containing at least one sulfonium site, organic compounds containing at least one selenonium site, organic compounds containing at least one iodonium site, and quaternary ammonium compounds having a formula NR_4^+ , where R is an alkyl, aromatic, or acyclic organic constituent, and combinations thereof.

38. The corrosion-inhibiting seal of claim 37 wherein the cationic solubility control agent is selected from H^+ , Li^+ , Na^+ , K^+ , Rb^+ , Cs^+ , NH_4^+ , Mg^{+2} , Ca^{+2} , Sr^{+2} , Y^{+3} , La^{+3} , Ce^{+3} , Ce^{+4} , Nd^{+3} , Pr^{+3} , Sc^{+3} , Sm^{+3} , Eu^{+3} , Eu^{+2} , Gd^{+3} , Tb^{+3} , Dy^{+3} , Ho^{+3} , Er^{+3} , Tm^{+3} , Yb^{+3} , Lu^{+3} , Ti^{+4} , Zr^{+4} , Ti^{+3} , Hf^{+4} , Nb^{+5} , Ta^{+5} , Nb^{+4} , Ta^{+4} , Mo^{+6} , W^{+6} , Mo^{+5} , W^{+5} , Mo^{+4} , W^{+4} , Mn^{+2} , Mn^{+3} , Mn^{+4} , Fe^{+2} , Fe^{+3} , Co^{+2} , Co^{+3} , Ru^{+2} , Ru^{+3} , Ru^{+4} , Rh^{+3} , Ir^{+3} , Rh^{+2} , Ir^{+2} , Pd^{+4} , Pt^{+4} , Pd^{+2} , Pt^{+2} , Cu^+ , Cu^{+2} , Cu^{+3} , Ag^+ , Ag^{+2} , Ag^{+3} , Au^+ , Au^{+2} , Au^{+3} , Zn^{+2} , Al^{+3} , Ga^{+3} , Ga^+ , In^{+3} , In^+ , Ge^{+4} , Ge^{+2} , Sn^{+4} , Sn^{+2} , Sb^{+3} , Sb^{+5} , Bi^{+3} , Bi^{+5} , organic compounds containing at least one N^+ site, organic compounds containing at least one phosphonium site, organic compounds containing at least one stibonium site, organic compounds containing at least one oxonium site, organic compounds containing at least one sulfonium site, organic compounds containing at least one iodonium site, and quaternary ammonium compounds having a formula NR_4^+ , where R is an alkyl, aromatic, or acyclic organic constituent, and combinations thereof.

39. The corrosion-inhibiting seal of claim 36 wherein the solubility control agent is the anionic solubility control agent selected from fluorotitanates, chlorotitanates, fluorozirconates, chlorozirconates, fluoroniobates, chloroniobates, fluorotantalates, chlorotantalates, molybdates, tungstates, permanganates, fluoromanganates, chloromanganates, fluoroferrates, chloroferrates, fluorocobaltates, chlorocobaltates, fluorozincates, chlorozincates, borates, fluoroborates, fluoroaluminates, chloroaluminates, carbonates, silicates, fluorosilicates, fluorostannates, nitrates, nitrites, azides, cyanamides, phosphates, phosphites, phosphonates, phosphinites, thiophosphates, thiophosphites, thiophosphonates, thiophosphinites, fluorophosphates, fluoroantimonates, chloroantimonates, sulfates, sulfites, sulfonates, thiosulfates, dithionites, dithionates, fluorosulfates, tellurates, fluorides, chlorides, chlorates, perchlorates, bromides, bromates, iodides, iodates, periodates, heteropolyanions, ferricyanides; ferrocyanides; cyanocobaltates; cyanocuprates; cyanomanganates; cyanates; cyanatoferrates; cyanatocobaltates; cyanatocuprates; cyanatomanganates; thiocyanates; thiocyanatoferrates; thiocyanatocobaltates; thiocyanatocuprates; thiocyanatomanganates; cyanamides; cyanamidoferrates; cyanamidocobaltates; cyanamidocuprates; cyanamidomanganates; nitritoferrates; nitritocobaltates; azides; (thio)carboxylates, di(thio)carboxylates, tri(thio)carboxylates, tetra(thio)carboxylates; (thio)phenolates, di(thio)phenolates, tri(thio)phenolates, tetra(thio)phenolates; (thio)phosphonates, di(thio)phosphonates, tri(thio)phosphonates; (thio)phosphonamides, di(thio)phosphonamides, tri(thio)phosphonamides; amino(thio)phosphonates, diamino(thio)phosphonates, triamino(thio)phosphonates; imino(thio)phosphonates, diimino(thio)phosphonates; (thio)sulfonates, di(thio)sulfonates, tri(thio)sulfonates; (thio)sulfonamides, di(thio)sulfonamides, tri(thio)sulfonamides; amino(thio)sulfonates, diamino(thio)sulfonates, triamino(thio)sulfonates; imino(thio)sulfonates, diimino(thio)sulfonates; (thio)borates, di(thio)borates, (thio)boronates; organic silicates; stibonates; cyanides; cyanochromates; cyanonickelates; cyanatochromates; cyanatonickeletes; thiocyanatochromates; thiocyanatonickeletes; cyanamidochromates; cyanamidonickeletes; nitritonickeletes; arsonates, diarsonates, triarsonates; organic selenates, diselenates, triselenates; arsenates, arsenites, fluoroarsenates, chloroarsenates, selenates, selenites, fluorothallates, chlorothallates, iodomercury anions, chloromercurates, bromomercurates, osmates, fluoronickeletes, chromates, Reinecke's salt, and vanadates, and combinations thereof.

40. The corrosion-inhibiting seal of claim 39 wherein the anionic solubility control agent is selected from fluorotitanates, chlorotitanates, fluorozirconates, chlorozirconates, fluoroniobates, chloroniobates, fluorotantalates, chlorotantalates, molybdates, tungstates, permanganates, fluoromanganates, chloromanganates, fluoroferrates, chloroferrates, fluorocobaltates, chlorocobaltates, fluorozincates, chlorozincates, borates, fluoroborates, fluoroaluminates, chloroaluminates, carbonates, silicates, fluorosilicates, fluorostannates, nitrates, nitrites, azides, cyanamides, phosphates, phosphites, phosphonates, phosphinites, thiophosphates, thiophosphites, thiophosphonates, thiophosphinites, fluorophosphates, fluoroantimonates, chloroantimonates, sulfates, sulfites, sulfonates, thiosulfates, dithionites, dithionates, fluorosulfates, tellurates, fluorides, chlorides, chlorates, perchlorates, bromides, bromates, iodides, iodates, periodates, heteropolyanions, ferricyanides; ferrocyanides; cyanocobaltates; cyanocuprates; cyanomanganates; cyanates; cyanatoferrates; cyanatocobaltates; cyanatocuprates; cyanatomanganates; thiocyanates; thiocyanatoferrates; thiocyanatocobaltates; thiocyanatocuprates; thiocyanatomanganates; cyanamides; cyanamidoferrates; cyanamidocobaltates; cyanamidocuprates; cyanamidomanganates; nitritoferrates; nitritocobaltates; azides; (thio)carboxylates, di(thio)carboxylates, tri(thio)carboxylates, tetra(thio)carboxylates; (thio)phenolates, di(thio)phenolates, tri(thio)phenolates, tetra(thio)phenolates; (thio)phosphonates, di(thio)phosphonates, tri(thio)phosphonates; (thio)phosphonamides, di(thio)phosphonamides, tri(thio)phosphonamides; amino(thio)phosphonates, diamino(thio)phosphonates, triamino(thio)phosphonates; imino(thio)phosphonates, diimino(thio)phosphonates; (thio)sulfonates, di(thio)sulfonates, tri(thio)sulfonates; (thio)sulfonamides, di(thio)sulfonamides, tri(thio)sulfonamides; amino(thio)sulfonates, diamino(thio)sulfonates, triamino(thio)sulfonates; imino(thio)sulfonates, diimino(thio)sulfonates; (thio)borates, di(thio)borates, (thio)boronates; organic silicates; and stibonates; and combinations thereof.

41. The corrosion-inhibiting seal of claim 1 further comprising a lubricity agent.

42. The corrosion-inhibiting seal of claim 41 wherein the lubricity agent is selected from molybdenum disulfide, fluorinated hydrocarbons, perfluorinated hydrocarbons, graphite, soft metal, and polymers, and combinations thereof.

43. The corrosion-inhibiting seal of claim 42 wherein the lubricity agent is the soft metal selected from tin, indium, and silver.

44. The corrosion-inhibiting seal of claim 1 wherein the corrosion-inhibiting seal has a color.

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45. The corrosion-inhibiting seal of claim 44 further comprising an agent which improves color-fastness of the corrosion-inhibiting seal.

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46. The corrosion-inhibiting seal of claim 45 wherein the agent which improves color-fastness is an active UV blocker or a passive UV blocker.

47. The corrosion-inhibiting seal of claim 46 wherein the agent which improves color-fastness is the active UV blocker selected from carbon black, graphite, and phthalocyanines.

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48. The corrosion-inhibiting seal of claim 46 wherein the agent which improves color-fastness is the passive UV blocker selected from titanium oxide, tin oxide, lead oxide, silicon oxide, silicates, and aluminosilicates, and combinations thereof.

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49. The corrosion-inhibiting seal of claim 45 wherein the agent which improves color-fastness is an agent which prevents smudging.

50. The corrosion-inhibiting seal of claim 49 wherein the agent which prevents smudging is selected from phosphoric acid, metaphosphates, orthophosphates, pyrophosphates, and polyphosphates, and combinations thereof.

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51. The corrosion-inhibiting seal of claim 45 wherein the agent which improves color-fastness is a wetting agent.

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52. The corrosion-inhibiting seal of claim 51 further comprising less than about 5 g/L of the wetting agent.

53. The corrosion-inhibiting seal of claim 51 wherein the wetting agent is a nonionic surfactant.

54. A method of making a corrosion-inhibiting sealing bath comprising:
 5 providing a solvent;
 providing a cobalt source;
 dissolving the cobalt source in the solvent;
 providing a valence stabilizer; and
 combining the cobalt source and the valence stabilizer to form a cobalt/valence stabilizer
 10 complex.

55. The method of claim 54 wherein the solvent comprises water.

56. The method of claim 54 wherein the cobalt source is selected from divalent cobalt
 15 sources, trivalent cobalt sources, and tetravalent cobalt sources, and combinations thereof.

57. The method of claim 56 wherein the cobalt source is divalent cobalt.

58. The method of claim 54 further comprising oxidizing the cobalt source.
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59. The method of claim 58 wherein the cobalt source is oxidized by adding an oxidizer to
 the corrosion-inhibiting sealing bath.

60. The method of claim 58 wherein the cobalt source is oxidized by electrolysis.
 25

61. The method of claim 59 wherein the oxidizer is a dissolved solid, a liquid, or a gas.

62. The method of claim 59 wherein the oxidizer is selected from peroxides, superoxides,
 persulfates, perborates, pernitrites, perphosphates, percarbonates, persilicates, peraluminates,
 30 pertitanates, perzirconates, permolybdates, pertungstates, pervanadates, organic peroxyacid
 derivatives, ozone, hypochlorites, chlorates, perchlorates, nitrates, nitrites, vanadates, iodates,

hypobromites, chlorites, bromates, permanganates, periodates, dissolved oxygen, dissolved chlorine, and dissolved fluorine, and combinations thereof.

63. The method of claim 54 wherein the cobalt source is selected from cobalt contained
 5 within a treated substrate, cobalt nitrate, cobalt sulfate, cobalt perchlorate, cobalt chloride, cobalt fluoride, cobalt bromide, cobalt iodide, cobalt bromate, cobalt chlorate, cobalt fluosilicate, cobalt fluotitanate, cobalt fluozirconate, cobalt fluoborate, cobalt fluoaluminate, cobalt formate, cobalt acetate, cobalt propionate, cobalt butyrate, cobalt benzoate, cobalt glycolate, cobalt lactate, cobalt tartronate, cobalt malate, cobalt tartrate, cobalt citrate, cobalt benzenesulfonate, cobalt
 10 thiocyanate, cobalt acetylacetonate, ammonium cobalt sulfate, ammonium cobalt nitrate, ammonium cobalt chloride, ammonium cobalt bromide, hexaamminecobalt chloride, hexaamminecobalt bromide, hexaamminecobalt nitrate, pentaamminecobalt chloride, pentaamminecobalt bromide, pentaamminecobalt nitrate, lithium cobaltinitrite, sodium cobaltinitrite, tris(ethylenediamine)cobalt chloride, tris(ethylenediamine)cobalt nitrate,
 15 bipyridine complexes of trivalent cobalt, phenanthroline complexes of trivalent cobalt, and cobaltcarbonates, and combinations thereof.

64. The method of claim 54 wherein the valence stabilizer is an inorganic valence stabilizer or an organic valence stabilizer.

65. The method of claim 54 further comprising adding an optional preparative agent to the corrosion-inhibiting sealing bath.

66. The method of claim 65 wherein the preparative agent is selected from fluorides,
 25 chlorides, bromides, acidic species, and hydroxides, and combinations thereof.

67. The method of claim 66 wherein the preparative agent is a fluoride.

68. The method of claim 67 wherein the fluoride is selected from fluorozirconates,
 30 fluorotitanates, fluorosilicates, fluoroaluminates, fluoroborates, fluorogallates, fluoroindates, fluorogermanates, fluorostannates, fluorophosphates, fluoroarsenates, fluoroantimonates,

fluorobismuthates, fluorosulfates, fluoroselenates, fluorotellurates, fluorocuprates, fluoroargentates, fluorozincates, fluorohafnates, fluorovanadates, fluoroniobates, fluorotantalates, fluoromolybdates, fluorotungstates, fluoroyttrates, fluorolanthanates, fluorocerates, fluoromanganates, fluoroferrates, fluoronickelates, fluorocobaltates, potassium fluoride, potassium hydrogen fluoride, sodium fluoride, sodium hydrogen fluoride, lithium fluoride, lithium hydrogen fluoride, ammonium fluoride, ammonium hydrogen fluoride, hydrofluoric acid, dissolved fluorine, and organic fluorides, and combinations thereof.

69. The method of claim 54 further comprising adding an optional solubility control agent to the corrosion-inhibiting sealing bath.

70. The method of claim 69 wherein the solubility control agent is a cationic solubility control agent or an anionic solubility control agent.

71. The method of claim 70 wherein the solubility control agent is the cationic solubility control agent selected from H^+ , Li^+ , Na^+ , K^+ , Rb^+ , Cs^+ , NH_4^+ , Mg^{+2} , Ca^{+2} , Sr^{+2} , Be^{+2} , Ba^{+2} , Y^{+3} , La^{+3} , Ce^{+3} , Ce^{+4} , Nd^{+3} , Pr^{+3} , Sc^{+3} , Sm^{+3} , Eu^{+3} , Eu^{+2} , Gd^{+3} , Tb^{+3} , Dy^{+3} , Ho^{+3} , Er^{+3} , Tm^{+3} , Yb^{+3} , Lu^{+3} , Ti^{+4} , Zr^{+4} , Ti^{+3} , Hf^{+4} , Nb^{+5} , Ta^{+5} , Nb^{+4} , Ta^{+4} , V^{+5} , V^{+4} , V^{+3} , Mo^{+6} , W^{+6} , Mo^{+5} , W^{+5} , Mo^{+4} , W^{+4} , Cr^{+3} , Mn^{+2} , Mn^{+3} , Mn^{+4} , Fe^{+2} , Fe^{+3} , Co^{+2} , Co^{+3} , Ni^{+2} , Ni^{+3} , Ni^{+4} , Ru^{+2} , Ru^{+3} , Ru^{+4} , Rh^{+3} , Ir^{+3} , Rh^{+2} , Ir^{+2} , Pd^{+4} , Pt^{+4} , Pd^{+2} , Pt^{+2} , Os^{+4} , Cu^+ , Cu^{+2} , Cu^{+3} , Ag^+ , Ag^{+2} , Ag^{+3} , Au^+ , Au^{+2} , Au^{+3} , Zn^{+2} , Cd^{+2} , Hg^+ , Hg^{+2} , Al^{+3} , Ga^{+3} , Ga^+ , In^{+3} , In^+ , Tl^{+3} , Tl^+ , Ge^{+4} , Ge^{+2} , Sn^{+4} , Sn^{+2} , Pb^{+4} , Pb^{+2} , Sb^{+3} , Sb^{+5} , As^{+3} , As^{+5} , Bi^{+3} , Bi^{+5} , organic compounds containing at least one N^+ site, organic compounds containing at least one phosphonium site, organic compounds containing at least one arsonium site, organic compounds containing at least one stibonium site, organic compounds containing at least one oxonium site, organic compounds containing at least one sulfonium site, organic compounds containing at least one selenonium site, organic compounds containing at least one iodonium site, and quaternary ammonium compounds having a formula NR_4^+ , where R is an alkyl, aromatic, or acyclic organic constituent, and combinations thereof.

72. The method of claim 71 wherein the cationic solubility control agent is selected from H^+ , Li^+ , Na^+ , K^+ , Rb^+ , Cs^+ , NH_4^+ , Mg^{+2} , Ca^{+2} , Sr^{+2} , Y^{+3} , La^{+3} , Ce^{+3} , Ce^{+4} , Nd^{+3} , Pr^{+3} , Sc^{+3} , Sm^{+3} ,

Eu⁺³, Eu⁺², Gd⁺³, Tb⁺³, Dy⁺³, Ho⁺³, Er⁺³, Tm⁺³, Yb⁺³, Lu⁺³, Ti⁺⁴, Zr⁺⁴, Ti⁺³, Hf⁺⁴, Nb⁺⁵, Ta⁺⁵,
 Nb⁺⁴, Ta⁺⁴, Mo⁺⁶, W⁺⁶, Mo⁺⁵, W⁺⁵, Mo⁺⁴, W⁺⁴, Mn⁺², Mn⁺³, Mn⁺⁴, Fe⁺², Fe⁺³, Co⁺², Co⁺³, Ru⁺²,
 Ru⁺³, Ru⁺⁴, Rh⁺³, Ir⁺³, Rh⁺², Ir⁺², Pd⁺⁴, Pt⁺⁴, Pd⁺², Pt⁺², Cu⁺, Cu⁺², Cu⁺³, Ag⁺, Ag⁺², Ag⁺³, Au⁺,
 Au⁺², Au⁺³, Zn⁺², Al⁺³, Ga⁺³, Ga⁺, In⁺³, In⁺, Ge⁺⁴, Ge⁺², Sn⁺⁴, Sn⁺², Sb⁺³, Sb⁺⁵, Bi⁺³, Bi⁺⁵, organic
 5 compounds containing at least one N⁺ site, organic compounds containing at least one
 phosphonium site, organic compounds containing at least one stibonium site, organic compounds
 containing at least one oxonium site, organic compounds containing at least one sulfonium site,
 organic compounds containing at least one iodonium site, and quaternary ammonium compounds
 having a formula NR₄⁺, where R is an alkyl, aromatic, or acyclic organic constituent, and
 10 combinations thereof.

73. The method of claim 70 wherein the solubility control agent is the anionic solubility
 control agent selected from fluorotitanates; chlorotitanates; fluorozirconates; chlorozirconates;
 fluoroniobates; chloroniobates; fluorotantalates; chlorotantalates; molybdates; tungstates;
 permanganates; fluoromanganates; chloromanganates; fluoroferrates; chloroferrates;
 fluorocobaltates; chlorocobaltates; fluorozincates; chlorozincates; borates; fluoroborates;
 fluoroaluminates; chloroaluminates; carbonates; silicates; fluorosilicates; fluorostannates;
 nitrates; nitrites; azides; cyanamides; phosphates; phosphates; phosphonates; phosphinites;
 thiophosphates; thiophosphites; thiophosphonates; thiophosphinites; fluorophosphates;
 fluoroantimonates; chloroantimonates; sulfates; sulfites; sulfonates; thiosulfates; dithionites;
 dithionates; fluorosulfates; tellurates; fluorides; chlorides; chlorates; perchlorates; bromides;
 bromates; iodides; iodates; periodates; heteropolyanions; ferricyanides; ferrocyanides;
 cyanocobaltates; cyanocuprates; cyanomanganates; cyanates; cyanatoferrates; cyanatocobaltates;
 cyanatocuprates; cyanatomanganates; thiocyanates; thiocyanatoferrates; thiocyanatocobaltates;
 25 thiocyanatocuprates; thiocyanatomanganates; cyanamides; cyanamidoferrates;
 cyanamidocobaltates; cyanamidocuprates; cyanamidomanganates; nitritoferrates;
 nitritocobaltates; azides; (thio)carboxylates; di(thio)carboxylates; tri(thio)carboxylates;
 tetra(thio)carboxylates; (thio)phenolates; di(thio)phenolates; tri(thio)phenolates;
 tetra(thio)phenolates; (thio)phosphonates; di(thio)phosphonates; tri(thio)phosphonates;
 30 (thio)phosphonamides; di(thio)phosphonamides; tri(thio)phosphonamides;
 amino(thio)phosphonates; diamino(thio)phosphonates; triamino(thio)phosphonates;

- imino(thio)phosphonates; diimino(thio)phosphonates; (thio)sulfonates; di(thio)sulfonates;
tri(thio)sulfonates; (thio)sulfonamides; di(thio)sulfonamides; tri(thio)sulfonamides;
amino(thio)sulfonates; diamino(thio)sulfonates; triamino(thio)sulfonates; imino(thio)sulfonates;
diimino(thio)sulfonates; (thio)borates; di(thio)borates; (thio)boronates; organic silicates;
5 stibonates; cyanides; cyanochromates; cyanonickelates; cyanatochromates; cyanatonickelates;
thiocyanatochromates; thiocyanatonickelates; cyanamidochromates; cyanamidonickelates;
nitritonickelates; arsonates; diarsonates; triarsonates; organic selenates; diselenates; triselenates;
arsenates; arsenites; fluoroarsenates; chloroarsenates; selenates; selenites; fluorothallates;
chlorothallates; iodo mercury anions; chloromercurates; bromomercurates; osmates;
10 fluoronickelates; chromates; Reinecke's salt; and vanadates; and combinations thereof.

74. The method of claim 73 wherein the anionic solubility control agent is selected from
fluorotitanates; chlorotitanates; fluoro zirconates; chloro zirconates; fluoroniobates;
chloroniobates; fluorotantalates; chlorotantalates; molybdates; tungstates; permanganates;
15 fluoromanganates; chloromanganates; fluoroferrates; chloroferrates; fluorocobaltates;
chlorocobaltates; fluoro zincates; chloro zincates; borates; fluoroborates; fluoroaluminates;
chloroaluminates; carbonates; silicates; fluoro silicates; fluoro stannates; nitrates; nitrites; azides;
cyanamides; phosphates; phosphates; phosphonates; phosphinites; thiophosphates;
thiophosphites; thiophosphonates; thiophosphinites; fluorophosphates; fluoroantimonates;
20 chloroantimonates; sulfates; sulfites; sulfonates; thiosulfates; dithionites; dithionates;
fluoro sulfates; tellurates; fluorides; chlorides; chlorates; perchlorates; bromides; bromates;
iodides; iodates; periodates; heteropolyanions; ferricyanides; ferrocyanides; cyanocobaltates;
cyanocuprates; cyanomanganates; cyanates; cyanatoferrates; cyanatocobaltates; cyanatocuprates;
cyanatomanganates; thiocyanates; thiocyanatoferrates; thiocyanatocobaltates;
25 thiocyanatocuprates; thiocyanatomanganates; cyanamides; cyanamidoferrates;
cyanamidocobaltates; cyanamidocuprates; cyanamidomanganates; nitritoferrates;
nitritocobaltates; azides; (thio)carboxylates; di(thio)carboxylates; tri(thio)carboxylates;
tetra(thio)carboxylates; (thio)phenolates; di(thio)phenolates; tri(thio)phenolates;
tetra(thio)phenolates; (thio)phosphonates; di(thio)phosphonates; tri(thio)phosphonates;
30 (thio)phosphonamides; di(thio)phosphonamides; tri(thio)phosphonamides;
amino(thio)phosphonates; diamino(thio)phosphonates; triamino(thio)phosphonates;

imino(thio)phosphonates; diimino(thio)phosphonates; (thio)sulfonates; di(thio)sulfonates;
tri(thio)sulfonates; (thio)sulfonamides; di(thio)sulfonamides; tri(thio)sulfonamides;
amino(thio)sulfonates; diamino(thio)sulfonates; triamino(thio)sulfonates; imino(thio)sulfonates;
diimino(thio)sulfonates; (thio)borates; di(thio)borates; (thio)boronates; organic silicates; and
stibonates; and combinations thereof .

75. The method of claim 54 wherein the corrosion-inhibiting sealing bath has a concentration
of cobalt between a minimum concentration of about 1×10^{-4} moles/liter cobalt and a maximum
concentration which is a maximum solubility of the cobalt source in the solvent at the bath
temperature.

76. The method of claim 59 wherein the corrosion-inhibiting sealing bath has a concentration
of oxidizer of between a minimum concentration such that a majority of the divalent cobalt is
oxidized to a trivalent or tetravalent oxidation state and a maximum concentration which is the
maximum solubility of the oxidizer in the solvent at the bath temperature.

77. The method of claim 66 wherein the corrosion-inhibiting sealing bath has a concentration
of the preparative agent of less than 5.0 M.

78. The method of claim 66 wherein the corrosion-inhibiting sealing bath has a concentration
of the preparative agent of less than 0.5 M.

79. The method of claim 54 wherein the corrosion-inhibiting sealing bath has a concentration
of valence stabilizer between a minimum concentration wherein there is a valence stabilizer-to-
cobalt ratio of 0.010 and a maximum concentration which is the maximum solubility of the
valence stabilizer precursor in the solvent at the bath temperature.

80. The method of claim 54 wherein the corrosion-inhibiting sealing bath has a pH of
between about 0 and about 9.

81. The method of claim 80 wherein the corrosion-inhibiting sealing bath has a pH of between about 1 and about 8.

82. The method of claim 54 wherein the corrosion-inhibiting sealing bath has a temperature of between about 5°C and about 100°C.

83. The method of claim 82 wherein the corrosion-inhibiting sealing bath has a temperature of between about 20°C and about 50°C.

84. A method of applying a corrosion-inhibiting seal to a barrier film, comprising:
providing the barrier film to be treated;
contacting the barrier film with a first corrosion-inhibiting sealing bath comprising a solvent and a cobalt source; and
contacting the barrier film with a valence stabilizer to form a seal comprising a cobalt/valence stabilizer complex.

85. The method of claim 84 wherein the valence stabilizer is added to the first corrosion-inhibiting sealing bath.

86. The method of claim 84 further comprising providing a second corrosion-inhibiting sealing bath comprising a second solvent and the valence stabilizer.

87. The method of claim 84 wherein the barrier film is a coating selected from oxides, hydroxides, phosphates, carbonates, oxalates, silicates, aluminates, borates, and polymers, and combinations thereof.

88. The method of claim 84 wherein the solvent comprises water.

89. The method of claim 84 wherein the cobalt source is selected from divalent cobalt, trivalent cobalt, and tetravalent cobalt, and combinations thereof.

90. The method of claim 89 wherein the cobalt source is divalent cobalt.

91. The method of claim 84 further comprising oxidizing the cobalt source.

5 92. The method of claim 91 wherein the cobalt source is oxidized in the corrosion-inhibiting sealing bath.

93. The method of claim 91 wherein the cobalt source is oxidized in the seal.

10 94. The method of claim 91 wherein the cobalt source is oxidized by adding an oxidizer to the first corrosion-inhibiting sealing bath.

95. The method of claim 91 wherein the cobalt source is oxidized by electrolysis.

15 96. The method of claim 94 wherein the oxidizer is a dissolved solid, a liquid, or a gas.

20 97. The method of claim 94 wherein the oxidizer is selected from peroxides, superoxides, persulfates, perborates, pernitrates, perphosphates, percarbonates, persilicates, peraluminates, pertitanates, perzirconates, permolybdates, pertungstates, pervanadates, organic peroxyacid derivatives, ozone, hypochlorites, chlorates, perchlorates, nitrates, nitrites, vanadates, iodates, hypobromites, chlorites, bromates, permanganates, periodates, dissolved oxygen, dissolved chlorine, and dissolved fluorine, and combinations thereof.

25 98. The method of claim 84 wherein the cobalt source is cobalt contained within a treated substrate, cobalt nitrate, cobalt sulfate, cobalt perchlorate, cobalt chloride, cobalt fluoride, cobalt bromide, cobalt iodide, cobalt bromate, cobalt chlorate, cobalt fluosilicate, cobalt fluotitanate, cobalt fluozirconate, cobalt fluoborate, cobalt fluoaluminate, cobalt formate, cobalt acetate, cobalt propionate, cobalt butyrate, cobalt benzoate, cobalt glycolate, cobalt lactate, cobalt tartronate, cobalt malate, cobalt tartrate, cobalt citrate, cobalt benzenesulfonate, cobalt
30 thiocyanate, cobalt acetylacetonate, ammonium cobalt sulfate, ammonium cobalt nitrate, ammonium cobalt chloride, ammonium cobalt bromide, hexaamminecobalt chloride,

hexaamminecobalt bromide, hexaamminecobalt nitrate, pentaamminecobalt chloride, pentaamminecobalt bromide, pentaamminecobalt nitrate, lithium cobaltinitrite, sodium cobaltinitrite, tris(ethylenediamine)cobalt chloride, tris(ethylenediamine)cobalt nitrate, bipyridine complexes of trivalent cobalt, phenanthroline complexes of trivalent cobalt, or cobaltcarbonates, or combinations thereof.

99. The method of claim 84 wherein the valence stabilizer is an inorganic valence stabilizer or an organic valence stabilizer.

100. The method of claim 84 wherein the barrier film is contacted with the corrosion-inhibiting sealing bath by immersion, spraying, fogging, wiping, or dipping.

101. The method of claim 84 further comprising adding an optional preparative agent to the first corrosion-inhibiting sealing bath.

102. The method of claim 101 wherein the preparative agent is selected from fluorides, chlorides, bromides, acidic species, and hydroxides, and combinations thereof.

103. The method of claim 102 wherein the preparative agent is a fluoride.

104. The method of claim 103 wherein the fluoride is selected from fluorozirconates, fluorotitanates, fluorosilicates, fluoroaluminates, fluoroborates, fluorogallates, fluorindates, fluorogermanates, fluorostannates, fluorophosphates, fluoroarsenates, fluoroantimonates, fluorobismuthates, fluorosulfates, fluoroselenates, fluorotellurates, fluorocuprates, fluoroargentates, fluorozincates, fluorohafnates, fluorovanadates, fluoroniobates, fluorotantalates, fluoromolybdates, fluorotungstates, fluoroyttrates, fluorolanthanates, fluorocerates, fluoromanganates, fluoroferrates, fluoronickelates, fluorocobaltates, potassium fluoride, potassium hydrogen fluoride, sodium fluoride, sodium hydrogen fluoride, lithium fluoride, lithium hydrogen fluoride, ammonium fluoride, ammonium hydrogen fluoride, hydrofluoric acid, dissolved fluorine, and organic fluorides, and combinations thereof.

105. The method of claim 84 further comprising contacting the seal comprising the cobalt/valence stabilizer complex with an optional solubility control agent.

106. The method of claim 105 wherein the solubility control agent is a cationic solubility control agent or an anionic solubility control agent.

107. The method of claim 106 wherein the solubility control agent is a cationic solubility control agent selected from H^+ , Li^+ , Na^+ , K^+ , Rb^+ , Cs^+ , NH_4^+ , Mg^{+2} , Ca^{+2} , Sr^{+2} , Be^{+2} , Ba^{+2} , Y^{+3} , La^{+3} , Ce^{+3} , Ce^{+4} , Nd^{+3} , Pr^{+3} , Sc^{+3} , Sm^{+3} , Eu^{+3} , Eu^{+2} , Gd^{+3} , Tb^{+3} , Dy^{+3} , Ho^{+3} , Er^{+3} , Tm^{+3} , Yb^{+3} , Lu^{+3} , Ti^{+4} , Zr^{+4} , Ti^{+3} , Hf^{+4} , Nb^{+5} , Ta^{+5} , Nb^{+4} , Ta^{+4} , V^{+5} , V^{+4} , V^{+3} , Mo^{+6} , W^{+6} , Mo^{+5} , W^{+5} , Mo^{+4} , W^{+4} , Cr^{+3} , Mn^{+2} , Mn^{+3} , Mn^{+4} , Fe^{+2} , Fe^{+3} , Co^{+2} , Co^{+3} , Ni^{+2} , Ni^{+3} , Ni^{+4} , Ru^{+2} , Ru^{+3} , Ru^{+4} , Rh^{+3} , Ir^{+3} , Rh^{+2} , Ir^{+2} , Pd^{+4} , Pt^{+4} , Pd^{+2} , Pt^{+2} , Os^{+4} , Cu^+ , Cu^{+2} , Cu^{+3} , Ag^+ , Ag^{+2} , Ag^{+3} , Au^+ , Au^{+2} , Au^{+3} , Zn^{+2} , Cd^{+2} , Hg^+ , Hg^{+2} , Al^{+3} , Ga^{+3} , Ga^+ , In^{+3} , In^+ , Tl^{+3} , Tl^+ , Ge^{+4} , Ge^{+2} , Sn^{+4} , Sn^{+2} , Pb^{+4} , Pb^{+2} , Sb^{+3} , Sb^{+5} , As^{+3} , As^{+5} , Bi^{+3} , Bi^{+5} , organic compounds containing at least one N^+ site, organic compounds containing at least one phosphonium site, organic compounds containing at least one arsonium site, organic compounds containing at least one stibonium site, organic compounds containing at least one oxonium site, organic compounds containing at least one sulfonium site, organic compounds containing at least one selenonium site, organic compounds containing at least one iodonium site, and quarternary ammonium compounds having a formula of NR_4^+ , where R is an alkyl, aromatic, or acyclic organic constituent, and combinations thereof.

108. The method of claim 107 wherein the cationic solubility control agent is selected from H^+ , Li^+ , Na^+ , K^+ , Rb^+ , Cs^+ , NH_4^+ , Mg^{+2} , Ca^{+2} , Sr^{+2} , Y^{+3} , La^{+3} , Ce^{+3} , Ce^{+4} , Nd^{+3} , Pr^{+3} , Sc^{+3} , Sm^{+3} , Eu^{+3} , Eu^{+2} , Gd^{+3} , Tb^{+3} , Dy^{+3} , Ho^{+3} , Er^{+3} , Tm^{+3} , Yb^{+3} , Lu^{+3} , Ti^{+4} , Zr^{+4} , Ti^{+3} , Hf^{+4} , Nb^{+5} , Ta^{+5} , Nb^{+4} , Ta^{+4} , Mo^{+6} , W^{+6} , Mo^{+5} , W^{+5} , Mo^{+4} , W^{+4} , Mn^{+2} , Mn^{+3} , Mn^{+4} , Fe^{+2} , Fe^{+3} , Co^{+2} , Co^{+3} , Ru^{+2} , Ru^{+3} , Ru^{+4} , Rh^{+3} , Ir^{+3} , Rh^{+2} , Ir^{+2} , Pd^{+4} , Pt^{+4} , Pd^{+2} , Pt^{+2} , Cu^+ , Cu^{+2} , Cu^{+3} , Ag^+ , Ag^{+2} , Ag^{+3} , Au^+ , Au^{+2} , Au^{+3} , Zn^{+2} , Cd^{+2} , Al^{+3} , Ga^{+3} , Ga^+ , In^{+3} , In^+ , Ge^{+4} , Ge^{+2} , Sn^{+4} , Sn^{+2} , Sb^{+3} , Sb^{+5} , Bi^{+3} , Bi^{+5} , organic compounds containing at least one N^+ site, organic compounds containing at least one phosphonium site, organic compounds containing at least one stibonium site, organic compounds containing at least one oxonium site, organic compounds containing at least one sulfonium site, organic compounds containing at least one iodonium site, and quarternary ammonium

compounds having a formula of NR_4^+ , where R is an alkyl, aromatic, or acyclic organic constituent, and combinations thereof.

109. The method of claim 106 wherein the solubility control agent is the anionic solubility control agent selected from fluorotitanates; chlorotitanates; fluorozirconates; chlorozirconates; fluoroniobates; chloroniobates; fluorotantalates; chlorotantalates; molybdates; tungstates; permanganates; fluoromanganates; chloromanganates; fluoroferrates; chloroferrates; fluorocobaltates; chlorocobaltates; fluorozincates; chlorozincates; borates; fluoroborates; fluoroaluminates; chloroaluminates; carbonates; silicates; fluorosilicates; fluorostannates; nitrates; nitrites; azides; cyanamides; phosphates; phosphates; phosphonates; phosphinites; thiophosphates; thiophosphites; thiophosphonates; thiophosphinites; fluorophosphates; fluoroantimonates; chloroantimonates; sulfates; sulfites; sulfonates; thiosulfates; dithionites; dithionates; fluorosulfates; tellurates; fluorides; chlorides; chlorates; perchlorates; bromides; bromates; iodides; iodates; periodates; heteropolyanions; ferricyanides; ferrocyanides; cyanocobaltates; cyanocuprates; cyanomanganates; cyanates; cyanatoferrates; cyanatocobaltates; cyanatocuprates; cyanatomanganates; thiocyanates; thiocyanatoferrates; thiocyanatocobaltates; thiocyanatocuprates; thiocyanatomanganates; cyanamides; cyanamidoferrates; cyanamidocobaltates; cyanamidocuprates; cyanamidomanganates; nitritoferrates; nitritocobaltates; azides; (thio)carboxylates; di(thio)carboxylates; tri(thio)carboxylates; tetra(thio)carboxylates; (thio)phenolates; di(thio)phenolates; tri(thio)phenolates; tetra(thio)phenolates; (thio)phosphonates; di(thio)phosphonates; tri(thio)phosphonates; (thio)phosphonamides; di(thio)phosphonamides; tri(thio)phosphonamides; amino(thio)phosphonates; diamino(thio)phosphonates; triamino(thio)phosphonates; imino(thio)phosphonates; diimino(thio)phosphonates; (thio)sulfonates; di(thio)sulfonates; tri(thio)sulfonates; (thio)sulfonamides; di(thio)sulfonamides; tri(thio)sulfonamides; amino(thio)sulfonates; diamino(thio)sulfonates; triamino(thio)sulfonates; imino(thio)sulfonates; diimino(thio)sulfonates; (thio)borates; di(thio)borates; (thio)boronates; organic silicates; stibonates; cyanides; cyanochromates; cyanonickelates; cyanatochromates; cyanatonickeletes; thiocyanatochromates; thiocyanatonickeletes; cyanamidochromates; cyanamidonickeletes; nitritonickeletes; arsonates; diarsonates; triarsonates; organic selenates; diselenates; triselenates; arsenates; arsenites; fluoroarsenates; chloroarsenates; selenates; selenites; fluorothallates;

chlorothallates; iodo mercury anions; chloromercurates; bromomercurates; osmates;
fluoronickelates; chromates; Reinecke's salt; and vanadates; and combinations thereof.

110. The method of claim 109 wherein the anionic solubility control agent is selected from
5 fluorotitanates; chlorotitanates; fluoro zirconates; chlorozirconates; fluoroniobates;
chloroniobates; fluorotantalates; chlorotantalates; molybdates; tungstates; permanganates;
fluoromanganates; chloromanganates; fluoroferrates; chloroferrates; fluorocobaltates;
chlorocobaltates; fluorozincates; chlorozincates; borates; fluoroborates; fluoroaluminates;
chloroaluminates; carbonates; silicates; fluorosilicates; fluorostannates; nitrates; nitrites; azides;
10 cyanamides; phosphates; phosphates; phosphonates; phosphinites; thiophosphates;
thiophosphites; thiophosphonates; thiophosphinites; fluorophosphates; fluoroantimonates;
chloroantimonates; sulfates; sulfites; sulfonates; thiosulfates; dithionites; dithionates;
fluorosulfates; tellurates; fluorides; chlorides; chlorates; perchlorates; bromides; bromates;
iodides; iodates; periodates; heteropolyanions; ferricyanides; ferrocyanides; cyanocobaltates;
15 cyanocuprates; cyanomanganates; cyanates; cyanatoferrates; cyanatocobaltates; cyanatocuprates;
cyanatomanganates; thiocyanates; thiocyanatoferrates; thiocyanatocobaltates;
thiocyanatocuprates; thiocyanatomanganates; cyanamides; cyanamidoferrates;
cyanamidocobaltates; cyanamidocuprates; cyanamidomanganates; nitritoferrates;
nitritocobaltates; azides; (thio)carboxylates; di(thio)carboxylates; tri(thio)carboxylates;
20 tetra(thio)carboxylates; (thio)phenolates; di(thio)phenolates; tri(thio)phenolates;
tetra(thio)phenolates; (thio)phosphonates; di(thio)phosphonates; tri(thio)phosphonates;
(thio)phosphonamides; di(thio)phosphonamides; tri(thio)phosphonamides;
amino(thio)phosphonates; diamino(thio)phosphonates; triamino(thio)phosphonates;
imino(thio)phosphonates; diimino(thio)phosphonates; (thio)sulfonates; di(thio)sulfonates;
25 tri(thio)sulfonates; (thio)sulfonamides; di(thio)sulfonamides; tri(thio)sulfonamides;
amino(thio)sulfonates; diamino(thio)sulfonates; triamino(thio)sulfonates; imino(thio)sulfonates;
diimino(thio)sulfonates; (thio)borates; di(thio)borates; (thio)boronates; organic silicates; and
stibonates; and combinations thereof.

111. The method of claim 84 wherein the corrosion-inhibiting sealing bath has a concentration
of cobalt between a minimum concentration of about 1×10^{-4} moles/liter cobalt and a maximum

concentration which is the maximum solubility of the cobalt precursor in the solvent at the bath temperature.

112. The method of claim 91 wherein the corrosion-inhibiting sealing bath has a concentration
5 of oxidizer between a minimum concentration such that a majority of the divalent cobalt is oxidized to a trivalent or tetravalent oxidation state and a maximum concentration which is the maximum solubility of the oxidizer in the solvent at the bath temperature.

113. The method of claim 102 wherein the corrosion-inhibiting sealing bath has a
10 concentration of preparative agent of less than 5.0 M.

114. The method of claim 102 wherein the corrosion-inhibiting sealing bath has a
concentration of preparative agent of less than 0.5 M.

115. The method of claim 84 wherein the corrosion-inhibiting sealing bath has a concentration
15 of valence stabilizer between a minimum concentration wherein there is a valence stabilizer-to-cobalt ratio of 0.010 and a maximum concentration which is the maximum solubility of the valence stabilizer precursor in the solvent at the bath temperature.

116. The method of claim 84 wherein the corrosion-inhibiting sealing bath has a pH of
20 between about 0 and about 9.

117. The method of claim 116 wherein the corrosion-inhibiting sealing bath has a pH of
between about 1 and about 8.

118. The method of claim 84 wherein the corrosion-inhibiting sealing bath has a temperature
25 of between about 5°C and about 100°C.

119. The method of claim 118 wherein the corrosion-inhibiting sealing bath has a temperature
30 of between about 20°C and about 50°C.